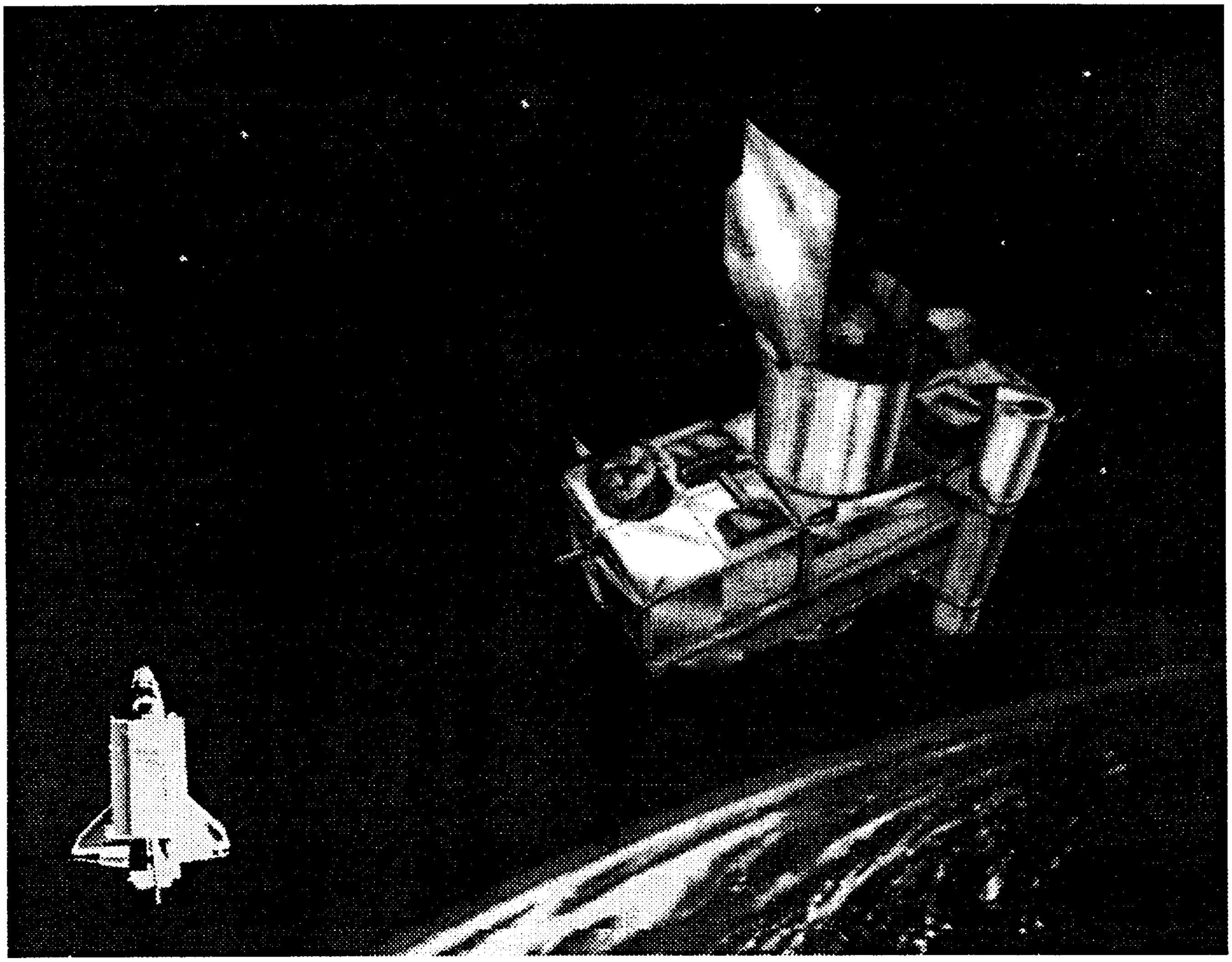
Pre Launch Mission Operation Report

Office of Life and Microgravity Sciences and Applications
Report No.



Orbiting Retrievable Far and Extreme Ultraviolet Spectrometer - Shuttle Pallet Satellite

ORFEUS-SPAS

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ORFEUS-SPAS 1

Prelaunch Mission Operation Report

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List of Acronyms

ACTS	Advanced Communications Technology Satellite
AIT	Astronomical Institute, Tübingen
CCAFS	Cape Canaveral Air Force Station
CCTV	Closed Circuit Television
CFK	Carbon Fiber Epoxy
CRISTA	Cryogenic Infrared Spectrometer and Telescope for Atmosphere
DARA	Deutsche Agentur für Rahmfahrtangelegenheiten (German Space Agency)
DASA	Deutsche Aerospace
DCU	Direct Command Unit
DLR	(German Institute for Research and Technology)
DPU	Data Processing Unit
DTR	Data Tape Recorder
EMU TV	EVA Maneuvering Unit Television
ERPCL	Extended Range Payload Communications Link
EUV	Extreme Ultraviolet
EVA	Extravehicular Activity
FUV	Far Ultraviolet
GPS	Global Positioning Satellite
GSFC	Goddard Space Flight Center
ICBC	IMAX Cargo Bay Camera
IMAPS	Interstellar Medium Absorption Profile Spectrograph
JIP	Joint Implementation Plan
JSC	Johnson Space Center
JSWT	Joint Science Working Group
km	Kilometer
KSC	Kennedy Space Center
L-	Launch Minus
LCC	Launch Commit Criteria
LSW	Landessternwarte, Heidelberg
LVLH	Local Vertical/Local Horizontal
MCC	Mission Control Center
MLI	Multilayer Insulation
MM	Millimeter
MOU	Memorandum of Understanding
nm	Nanometer
ORFEUS	Orbiting, Retrievable, Far and Extreme Ultraviolet Spectrometer
PI	Payload Interrogator, also Principle Investigator
PIP	Payload Integration Plan
POCC	Payload Operations Control Center
POD	Payload Operations Director
RICS	Remote IMAX Camera System
RMS	Remote Manipulator System
SESAM	Surface Effects Sample Monitor
SPAS	Shuttle Pallet Satellite
SPEE	Special Purpose End Effector
SPOC	SPAS Payload Operations Center
STS	Space Transportation System
TAGS	Text and Graphics System
TDRS	Tracking and Data Relay Satellite
TOS	Transfer Orbital Stage
UCB	University of California, Berkeley

Foreword

MISSION OPERATION REPORTS are published expressly for the use of NASA senior management, as required by the Administrator in NASA Management Instruction (NMI) 8610.1C, dated November 26, 1991. The purpose of these reports is to provide NASA senior management with timely, complete, and definitive information on flight mission plans, and to establish official mission objectives that provide the basis for assessment of mission accomplishment.

Reports are prepared and issued for each flight project just prior to launch. Following launch, updated reports for each mission are issued to keep management currently informed of definitive mission results as provided in NASA Management Instruction HQMI 8610.1C.

These reports are sometimes highly technical and are for personnel having program/project management responsibilities. The Public Affairs Division publishes a comprehensive series of reports on NASA flight missions, which are available for dissemination to the news media.

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1.0 General

The Orbiting, Retrievable, Far and Extreme Ultraviolet Spectrometer - Shuttle Pallet Satellite (ORFEUS-SPAS) mission is the first of a series of at least 4 joint science cooperative missions between NASA and DARA which will utilize the ASTRO-SPAS carrier platform. ORFEUS-SPAS consists of 3 ultraviolet spectrographs which will obtain spectral data on a number of celestial targets; an optical materials experiment; and the Remote IMAX Camera System (RICS) which will obtain footage of the ORFEUS-SPAS deployment operations.

After shuttle launch and ORFEUS-SPAS check-out, the spacecraft is deployed by the RMS while RICS records the deployment on special large format film. During science operations, ORFEUS-SPAS is controlled from the SPAS Payload Control center (SPOC) located at KSC, and only one of the three spectrographs are in data collection mode at any one time.

Spectral data are recorded on the SPAS tape recorder system for postflight analysis. However, a small amount of science data is downlinked with engineering data for "quick-look" analysis and systems performance evaluation.

At the end of the science phase of the ORFEUS-SPAS mission, the spacecraft is recovered and reberthed into the orbiter for return to earth and refurbishment for the next ASTRO-SPAS mission.

ORFEUS-SPAS is manifested on STS-51 on board *Discovery*, which will also launch the ACTS/TOS payload, currently targeted for launch in mid-July, 1993. The STS-51 mission is planned to be 9 days in duration, with the possibility of extending one day, if resources allow.

2.0 Mission Objectives

Program Objective:

The objective of the ORFEUS mission is to launch a deployable/retrievable astronomical platform and obtain ultraviolet spectra for both astrophysically interesting sources and the intervening interstellar medium.

Also, the IMAX cameras will obtain footage of both the Shuttle and the ORFEUS-SPAS satellite during the deployment/retrieval operations phase of the ORFEUS-SPAS mission.

Science Objectives:

Obtain scientifically useful spectra in the Far Ultraviolet (FUV) or Extreme Ultraviolet (EUV) region, from at least one of the two ORFEUS spectrometers, for the purpose of learning about stellar sources and the interstellar medium, and/or perform high resolution spectroscopy on bright FUV sources for the purpose of characterizing the intervening interstellar medium using the Interstellar Medium Absorption Profile Spectrometer (IMAPS).

Objects of prime interest for the ORFEUS spectrographs are white dwarfs, cataclysmic variables, young OB sequence stars, coronal sources, supernovae remnants, extragalactic sources and both hot and cool phases of the interstellar medium.

Objectives of prime interest for IMAPS are bright O and B type stars whose spectra contain information on the intervening interstellar gas.

Obtain data on the degradation of optical materials when exposed to space flight conditions using the Surface Effects Sample Monitor (SESAM).

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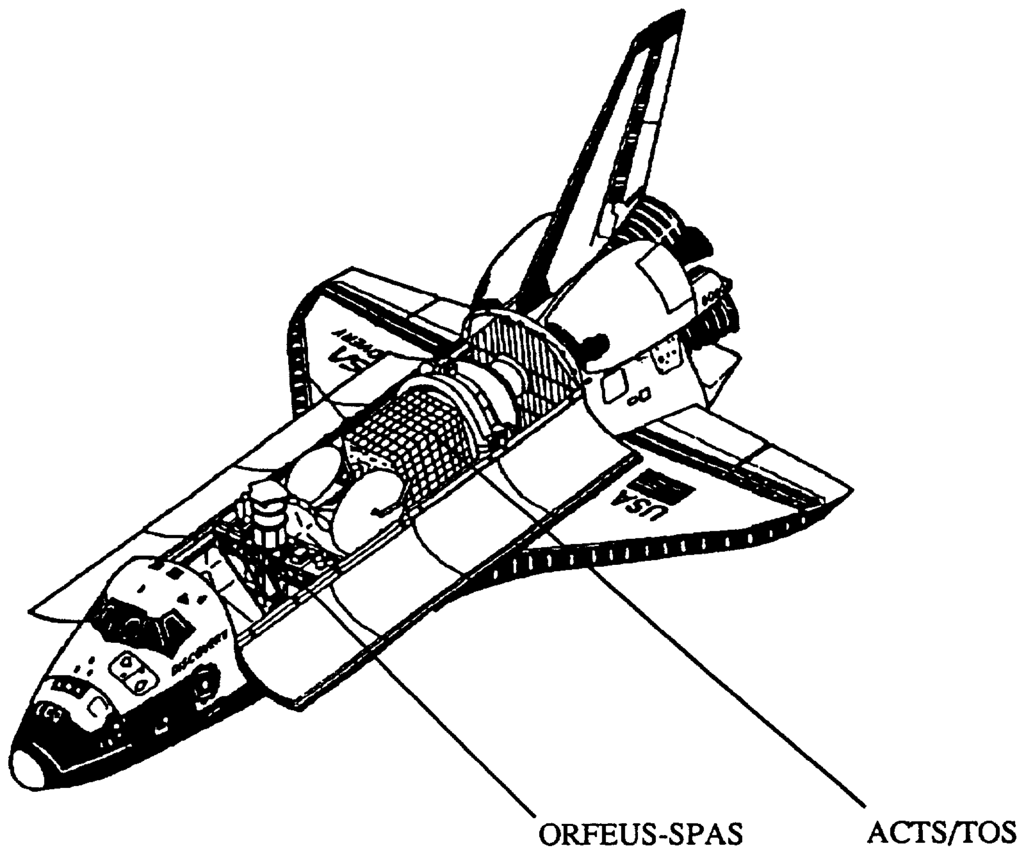
3.0 Mission Description

The STS-51 mission is composed of two primary payloads; the Advanced Communications Technology Satellite/Transfer Orbit Stage (ACTS/TOS) and ORFEUS-SPAS. Launch will be a direct insertion into a 296 km orbit where ACTS/TOS is planned to be deployed on flight day 1. After the ACTS/TOS deployment, the orbiter then circularizes its orbit and deploys ORFEUS-SPAS on flight day 2. ORFEUS-SPAS science is then conducted until flight day 7 when ORFEUS-SPAS is retrieved (unless a one day mission extension is granted). The primary landing site is KSC.

STS-51 Cargo Configuration



LAUNCH:	July 15, 1993, (launch window is 9:18 am to 10:28 am EDT)
STS FLIGHT NUMBER:	STS-51
ORBITAL VEHICLE:	Discovery (OV 103)
ORBITAL ALTITUDE/ INCLINATION:	290 km/28.5°
DURATION:	9+(1)+2 Days
LANDING:	KSC
CREW:	Commander: F. Culbertson Pilot: W. Readdy Mission Specialist: D. Bursch Mission Specialist: J. Newman Mission Specialist: C. Walz

3.1 Payload Description

The ORFEUS-SPAS spacecraft consists of the ASTRO-SPAS carrier and subsystems; the ORFEUS telescope with both the FUV and EUV spectrometers; the IMAPS spectrograph, SESAM; and RICS/ EMU TV.

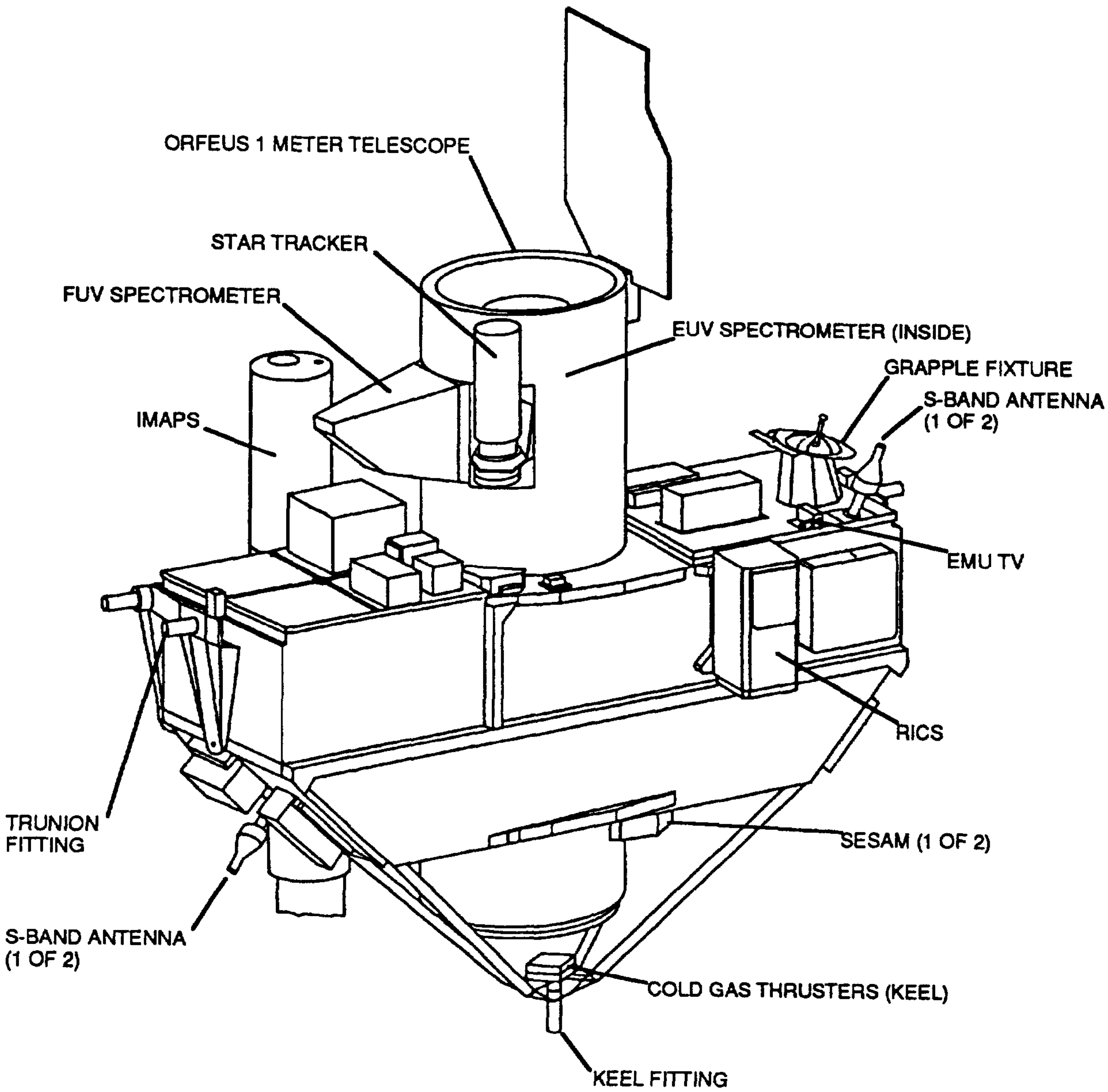


Figure 3.1-1 ORFEUS-SPAS Configuration

3.1.1 SPAS Carrier

The ASTRO-SPAS spacecraft can trace its heritage back to the SPAS-01 satellite (June 1983), the SPAS-01A (February 1984) and Infrared Background Signature Survey (April 1991). ASTRO-SPAS was designed to be a reusable, low cost satellite that is launched, deployed, retrieved and returned to Earth using the Space Shuttle. It is designed to accommodate primarily large telescopes and spectrometers, but also may carry various supplemental experiments.

The ASTRO-SPAS structure subsystem is a primary truss framework made of carbon fiber tubes with titanium nodes. The secondary structure is provided by interchangeable equipment support panels which also serve as mounting plates for subsystem and payload components. The end result is a very rigid, stable, light weight, optical platform. Thermal regulation is passive, accomplished through the use of multilayer insulation (MLI) blankets.

Power for all ASTRO-SPAS and payload systems is provided by a modular battery pack comprised of state of the art lithium sulfite ($LiSO_2$) battery cells and its associated power distribution system. Data are recorded through an on-board processor and data tape recorder and stored for post-flight analysis. Some quick look and systems data are transmitted to the ground for performance analysis.

For position determination and 3-axis stabilized attitude control, rate integrating gyroscopes along with a high precision star tracker and a cold gas (N_2) thruster system are used. For ORFEUS-SPAS a Global Positioning Satellite (GPS) receiver will also be flown as a systems demonstration test for the upcoming CRISTA-SPAS mission. Interactive command and control are provided via an S-band link via the Extended Range Payload Communications Link (ERPCL) on-board the Shuttle which then communicates with the ground via the Ku system. ASTRO-SPAS has a grapple fixture for deploy and reberth with power and data interfaces for spacecraft check-out while attached to the Remote Manipulator System (RMS).

3.1.2 ORFEUS Telescope

ORFEUS is an astronomical telescope for observations at very short wavelengths in two spectral ranges, the Far Ultraviolet (FUV) in the range 90 to 125 nm and the Extreme Ultraviolet (EUV) from 40 to 90 nm. (See Figure 3.1.2-1).

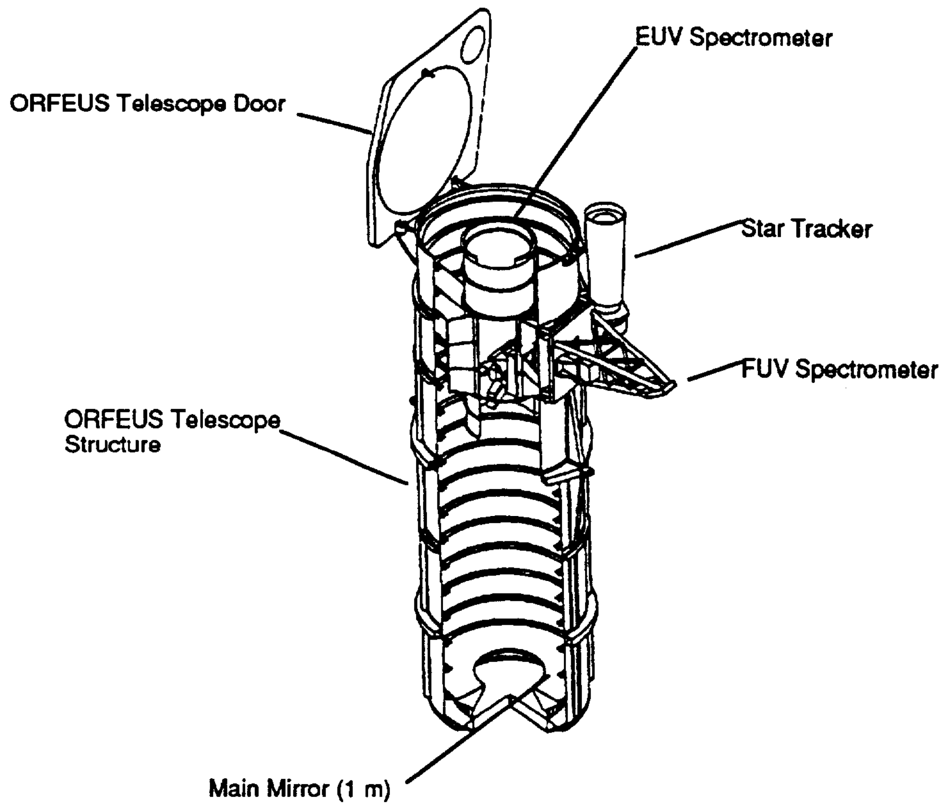


Figure 3.1.2-1 ORFEUS Telescope

The overall design and construction of the ORFEUS Telescope and of the FUV(Echelle) spectrometer has been developed by Astronomical Institute, Tübingen (AIT) together with Landessternwarte (LSW). The detailed design and construction was performed by Kayser Threde Inc., Munich. The main mirror (Schott Zerodur) has been polished and mounted by the REOSC company in France. Design and manufacturing of the telescope tube was done at MAN, Munich. The main mirror is a paraboloid with a diameter of 1000 mm and a focal length of 2426 mm with an iridium coating to improve its reflectivity. The telescope tube is made of a carbon fiber epoxy compound (CFK).

This tube is highly stable against mechanical and thermal load deformations, which is very essential to keep the instruments final adjustment during launch and at deep space temperatures in orbit.

The primary mirror bundles the beam in the primary focus where a mechanical aperture limits the field of view. With the collimator mirror in "off" position the undeflected beam will enter into the EUV-Spectrograph (a design which incorporates a set of four novel spherically figured, varied line-space gratings used in a geometry which is similar to that of the classic Rowland mount). Alternatively, when the collimator mirror is moved into the beam, the light is deflected into the FUV-Spectrograph.

3.1.3.1 Far Ultraviolet Spectrometer (FUV)

All information which we receive from a star is comprised in its light, or more precisely in its spectral intensity distribution. It is therefore important to resolve the light spectrally as far as possible with the constraint that the amount of light limits, i.e. the size of the telescope, the useful observing time and the strength of the sources. In order to achieve the highest possible resolution with the ORFEUS telescope an Echelle spectrometer was conceived. Its main characteristic is that two diffraction gratings disperse the light very effectively with the result of an especially wide spread spectrum. Spectral features seperated by 0.01 nm, (1/10,000 of the wavelength), can be resolved. This spectrum is projected onto a two-dimensional microchannel plate detector which is extremely sensitive with a very low background noise. Thus even rather faint sources can be investigated with full spectral resolution.

3.1.3.2 Extreme Ultraviolet Spectrometer

After striking the telescope mirror, incoming rays of light are directed to one of four novel diffraction gratings. Due to unique characteristics of the gratings, the sharpness of the images formed by the high quality telescope mirror is retained in the dispersed light, allowing a much higher spectral resolution to be achieved than would be possible with conventional diffraction gratings. The detectors which record the arrival position of each ray of light do so with an accuracy better than 40 micrometers, less than half the thickness of a typical human hair, and encode this arrival position electronically.

The EUV Spectrometer is being built by the Space Astrophysics Group at the University of California, Berkeley (UCB) under the direction of the Principal Investigator, Prof. Stuart Bowyer, and Instrument Scientist, Dr. Mark Hurwitz. NASA provides funding for the fabrication of this instrument, which mounts to the spider structure in the upper half of the ORFEUS telescope tube. The EUV spectrometer accepts light from the ORFEUS telescope primary mirror, as does the Far Ultraviolet (FUV) Echelle spectrometer built by Tübingen and LSW, although the two spectrometers do not operate simultaneously. The EUV instrument covers the wavelength region from 40 to 120 nanometers. Its resolving power is about 1 part in 5000. To achieve high spectral resolution across such a large wavelength range, a new spectrometer design, never before flown in space, was developed. It utilizes four unique diffraction gratings fabricated by the Central Research Laboratory of Hitachi Instruments near Tokyo, Japan. The diffraction gratings have as many as 6000 parallel grooves per mm on their surface to disperse the light into its component EUV "colors." The spacing of the grooves varies across the surface of each grating to reduce spectral aberrations. The instrument employs a radically new type of detector, developed by Space Astrophysics Group personnel. These detectors can electronically record the position of each photon of light with a precision better than 30 micrometers and are about twice as long as any previously flown detector, representing an unprecedented level of performance.

3.1.4 IMAPS

Interstellar Medium Absorption Profile Spectrometer (IMAPS) is an instrument which is specially designed to study the large contrasts in the chemical and physical properties of the interstellar medium and help us to understand the interactions between different types of gas. While ASTRO-SPAS is operating in orbit, IMAPS will observe ultraviolet radiation from hot, bright stars and will record how the light is altered by different atoms, ions and molecules which create unique patterns of absorption at different wavelengths. The design of IMAPS has two special features: first, it works in a wavelength region which is very important for studying principal constituents of the medium (95 -115 nm), and second, it has a very high spectral resolving power which permits it to disentangle the Doppler shifts of parcels of gas which are moving very slowly with respect to each other (at relative speeds of order 1 km/s).

The construction of IMAPS is very simple. Housed within a cylindrical enclosure are 4 elements:

1. a mechanical collimator with aligned apertures to block the light from stars other than the desired target,
2. an Echelle grating which disperses the light so that it is separated into different wavelengths,
3. another, low-power grating on a curved surface which eliminates some overlapping of different wavelengths from the Echelle grating and also focuses the light beam, and
4. a specially developed ultraviolet image sensor that has very high sensitivity.

IMAPS is planned to operate for a total 1 day on the ORFEUS-SPAS mission and record the spectra of about 15 stars.

3.1.5 Remote IMAX Camera System (RICS)

The RICS camera is a modified IMAX cargo bay camera (ICBC) mounted to ORFEUS-SPAS for filming orbiter scenes during RMS and freeflight operations. The RICS is an IMAX camera enclosed in a container to protect it from contamination and provide a controlled environment for the camera and film. The container has a door assembly which opens for filming operations. The RICS has both a power and a signal harness to interface the camera electronics on the top cover with the ORFEUS-SPAS power distribution system. All RICS command, data, and power interfaces are through the ORFEUS-SPAS.

RICS filming operation are commanded by both the SPOC and the crew. Crew control of the camera is via the RICS-ORFEUS onboard display.

3.1.6 EVA Maneuvering Unit (EMU) Television (TV)

The RICS does not give the SPOC or the crew the capability to view scenes being filmed in real-time. Therefore, aiding in the RICS filming operations is an EMU TV also mounted to the ORFEUS-SPAS.

The EMU TV is a video camera with a transmitter and associated electronics. The EMU TV camera field of view is co-aligned with the RICS camera field of view. Therefore, an eqivalent scene to that seen by the RICS camera is transmitted to the orbiter and downlinked in real-time.

The EMU TV transmits its video signal to the orbiter Closed Circuit Television (CCTV) system through the orbiter EMU receiver. The CCTV system can be used to display the scene on the TV monitors or to downlink the video signal to the ground during times of Tracking and Data Relay Satellite (TDRS) Ku-band signal coverage.

3.1.7 SESAM

The Surface Effects Sample Monitor (SESAM) experiment is designed to study the effects of contaminants and atomic oxygen on optical materials during spaceflight. A number of different optical coatings are exposed for various lengths of time during the mission, and then analyzed post-flight for degradation in reflectivity. Data from this experiment will assist in the planning and use of optical coatings for future flights. (See Figure 3.1.7-1).

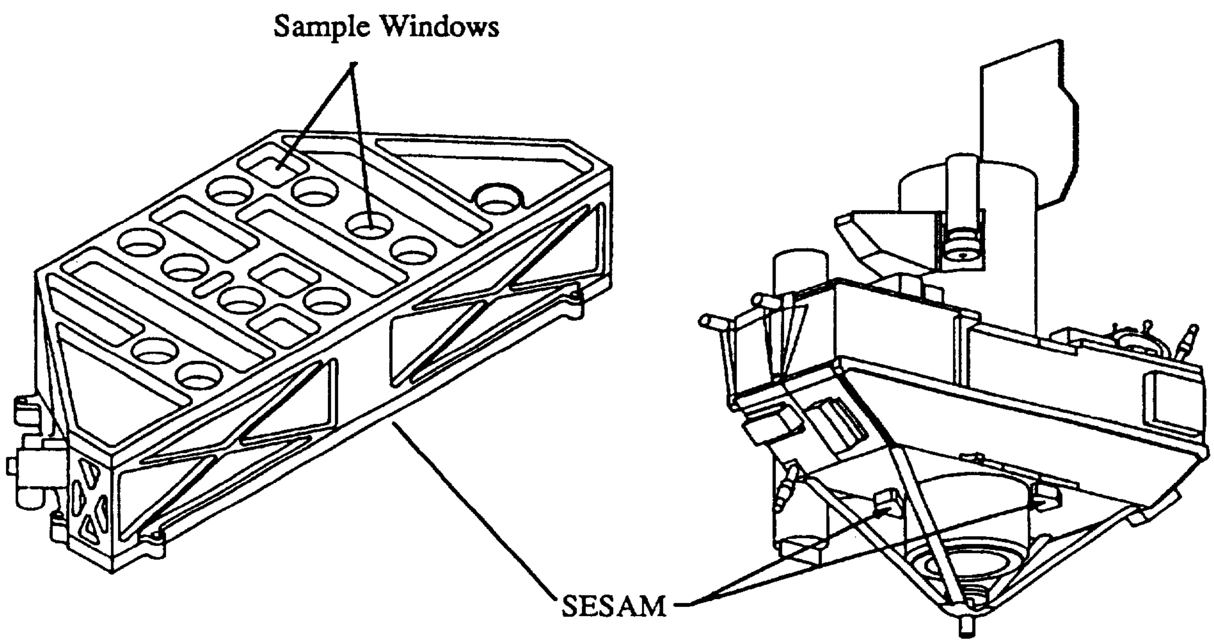


Figure 3.1.7-1 SESAM

4.0 Mission Sequence

The ORFEUS-SPAS mission is divided into six distinct phases:

1. Launch and ascent
2. Deployment operations
3. Post release operations
4. ORFEUS-SPAS free flight
5. Rendezvous and retrieval
6. Berthing and landing

4.1 Launch and Ascent

IMAPS telescope servicing occurs up to L-72 hours. This servicing consists of providing a dry nitrogen (N_2) or dry air purge. There are no prelaunch activities after L-72 hours and no payload launch commit criteria (LCC) for ORFEUS-SPAS. The other payload on STS-51, ACTS, however, does have launch window constraints due to orbit insertion requirements. These constraints dictate a launch window of approximately 1 hour and 10 minutes in duration. There are no scrub turn around constraints for ORFEUS-SPAS through a 48 hour launch delay. If the launch is delayed beyond 48 hours, IMAPS will require reconnection of the purge to ensure the humidity in the interior of the instrument remains below specified levels.

The ORFEUS-SPAS is completely unpowered throughout this mission phase. Although no payload activities occur until the deployment phase, ORFEUS attitude constraints begin at payload bay door opening. These constraints require the Sun be kept at least 8° off from the star tracker boresight to prevent damage to the star tracker.

4.2 Deployment Operations

If ACTS/TOS is deployed as planned on flight day 1, on flight day 2, the ORFEUS-SPAS is grappled by the Remote Manipulator System (RMS) and powered on through an interface established by the Special Purpose End Effector (SPEE) attached to the end of the RMS. The Remote IMAX Camera System (RICS) is powered on via the same interface at this time to allow a 1 to 5 hour warm-up period prior to filming. The ORFEUS-SPAS transmitter is enabled, and the command and data links are established. The SPOC then commands the ORFEUS-SPAS through an extensive predeploy checkout to ensure all systems are operating nominally. The checkout includes a verification of the Data Processing Unit (DPU) and the Direct Command Unit (DCU) command capabilities and a power down and repower of the SPAS.

Following the repower of the SPAS, the communications link is reestablished and the SPAS predeploy checkout continues. The SPAS gyros are then calibrated while the ORFEUS-SPAS is still berthed. At the conclusion of the gyro calibration and predeploy checkout, the SPAS data tape recorder (DTR) is reset, and the SPAS is unberthed and maneuvered to deploy position. The RICS standby is powered on, and adjustments of aperture range and focuses are performed to setup for filming the SPAS release. Upon a "go" call from the SPOC, the ORFEUS-SPAS is released by the RMS.

4.3 Post-release Operations

Upon release of ORFEUS-SPAS from the RMS, the orbiter separates from ORFEUS-SPAS with RICS filming the sequence. Simultaneous with RICS filming, immediately after release, ORFEUS-SPAS performs an inertial attitude hold while the SPOC acquires the ORFEUS-SPAS inertial reference. A second gyro calibration is then performed. The ORFEUS-SPAS is then commanded to maneuver to a new RICS filming attitude. ORFEUS-SPAS then performs an inertial attitude hold while the SPOC defines the ORFEUS-SPAS inertial reference and gyro calibration. When the gyro calibration is complete, ORFEUS-SPAS continues to maneuver to new attitudes to support RICS filming objectives. Approximately 45 minutes after release, the orbiter may station keep with the ORFEUS-SPAS until the Sun is at a proper angle to support RICS filming of the next orbiter separation burn. After the orbiter separation from ORFEUS-SPAS is complete, the orbiter then maneuvers to a predetermined station keeping attitude for ORFEUS-SPAS free-flight operations. A minimum of 7.5 hours of continuous orbiter-to-ORFEUS-SPAS communication is required post release to achieve the above objectives and to configure the SPAS experiments for autonomous operations.

4.4 ORFEUS-SPAS Free Flight

The ORFEUS-SPAS free-flight mission phase is planned to last at least 96 hours with a maximum of 200 hours, during which time the ORFEUS-SPAS maneuvers between inertial attitudes approximately every 25 minutes depending upon available science targets. The ORFEUS and IMAPS telescopes are operated alternatively, and only one of the two ORFEUS spectrometers is active at any time. A communications link between the SPOC and the ORFEUS-SPAS via the orbiter is established for 90 minutes every third orbit as a minimum to load new targets for science data takes and to support experiment health checks. This link is established using either the orbiter Payload Interrogator (PI) or the Extended Range Payload Communications Link (ERPCL). The ERPCL is the prime system, and the PI is a backup to the ERPCL. If the PI is used, the orbiter is required to perform extensive maneuvers to establish and maintain the necessary range to support the ORFEUS-SPAS communications requirements. The ERPCL does not require extensive orbiter maneuvers due to its capability of maintaining a communications link for an extended range.

4.5 Rendezvous and Retrieval

At the completion of the ORFEUS-SPAS science mission and five hours prior to grapple, a continuous PI lock is established with ORFEUS-SPAS to configure the spacecraft for retrieval. This includes powering down the science and commanding the ORFEUS and IMAPS telescope doors closed and latched. Nominally, the ORFEUS-SPAS will be oriented in a stable local vertical/local horizontal (LVLH) attitude compatible with retrieval prior to the orbiter closing for rendevous. The orbiter performs a standard rendezvous sequence to approach the ORFEUS-SPAS for grapple. After verifying that ORFEUS-SPAS is in the proper attitude, the crew grapples the spacecraft and establishes the SPEE electrical interface with the SPAS.

4.6 Berthing

If required, the crew visually verifies that the ORFEUS and IMAPS doors are closed prior to berthing. The ORFEUS door and at least one of the two IMAPS doors are closed for the payload to be considered safe for return. An extra vehicular activity (EVA) is possible to close a telescope door in a contingency situation. The ORFEUS-SPAS attitude measurements and control system and transmitter are powered off, and final RICS filming is supported if conditions allow. ORFEUS-SPAS is then berthed and completely powered down. The SPEE interface is disconnected electrically and ungrappled. The ORFEUS-SPAS mission is complete at this point.

5.0 Mission Support

The mission support organization is shown in Figure 5.0-1. The SPAS Mission Manager directs the SPOC activities and is responsible for the operational success of the ORFEUS-SPAS mission. SPAS REP coordinates the various functions within the SPOC and communicates with the JSC Payload Officer for and inflight changes to the deploy/retrieval timeline.

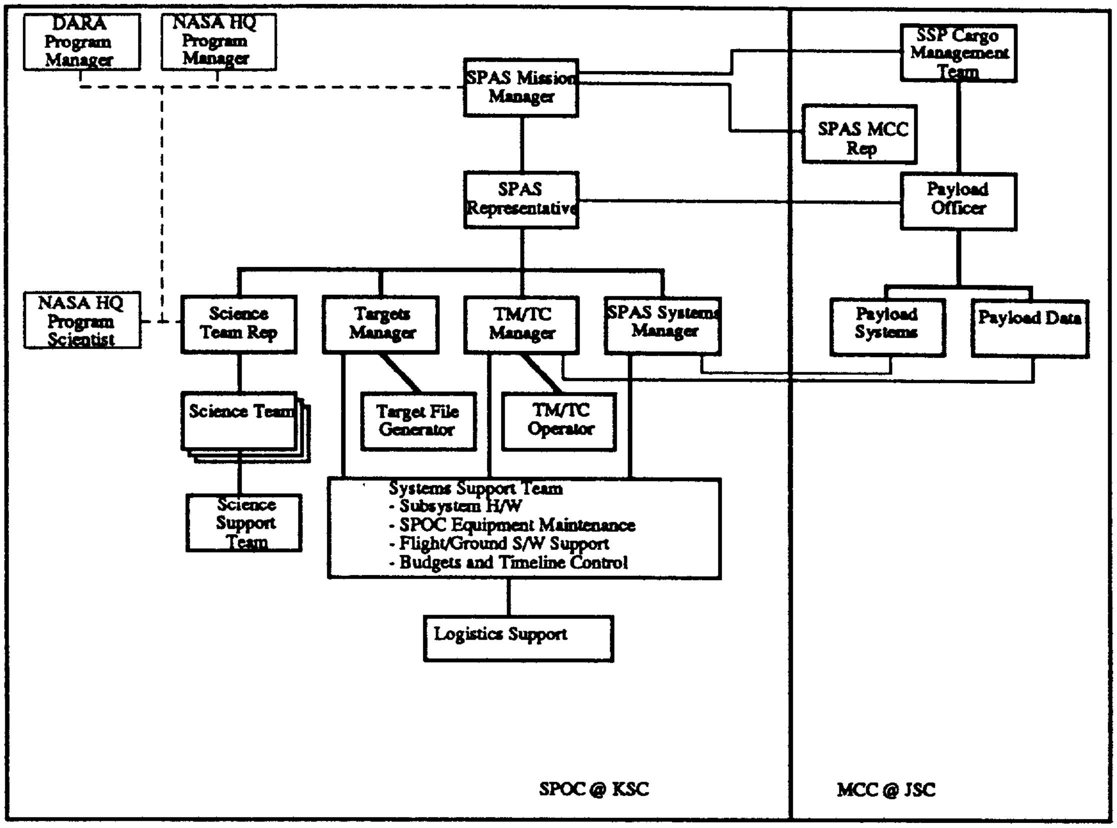


Figure 5.0-1 ORFEUS--SPAS Mission Support

Nominal operations during ORFEUS-SPAS free-flight, as shown in Figure 5.0-2, are accomplished via a command link from the SPOC through the JSC MCC, up through TDRS to the Shuttle which then relays commands to the ORFEUS-SPAS spacecraft. Downlink data are transmitted from the Shuttle to TDRS back to the SPOC in real-time where spacecraft and instrument performance is analyzed. Real time mission support is provided at JSC by the Payload Officer in the MCC. Coordination between the KSC SPOC and the JSC MCC is accomplished by dedicated voice communications links.

KSC will be used as the ORFEUS-SPAS payload operations control center, or remote Payload Operations Control Center (POCC). The same KSC facility, Hangar AM, that is used to integrate and test the ORFEUS-SPAS for flight will also house the SPAS Payload Operations Control center (SPOC). From the SPOC, all SPAS commands will be initiated and the science area of the SPOC will receive ORFEUS, IMAPS and SPAS systems data for quick look analyses and telescope performance evaluation.

The local operational responsibility for the execution of the mission lies with the SPAS REP. This function is similar to that of the Payload Operations Director (POD) function in the Spacelab program. This function coordinates all of the SPOC flight control team through the JSC Payload Officer. All requests for action on the part of the STS as well as the ORFEUS-SPAS commands are focused through this interface.

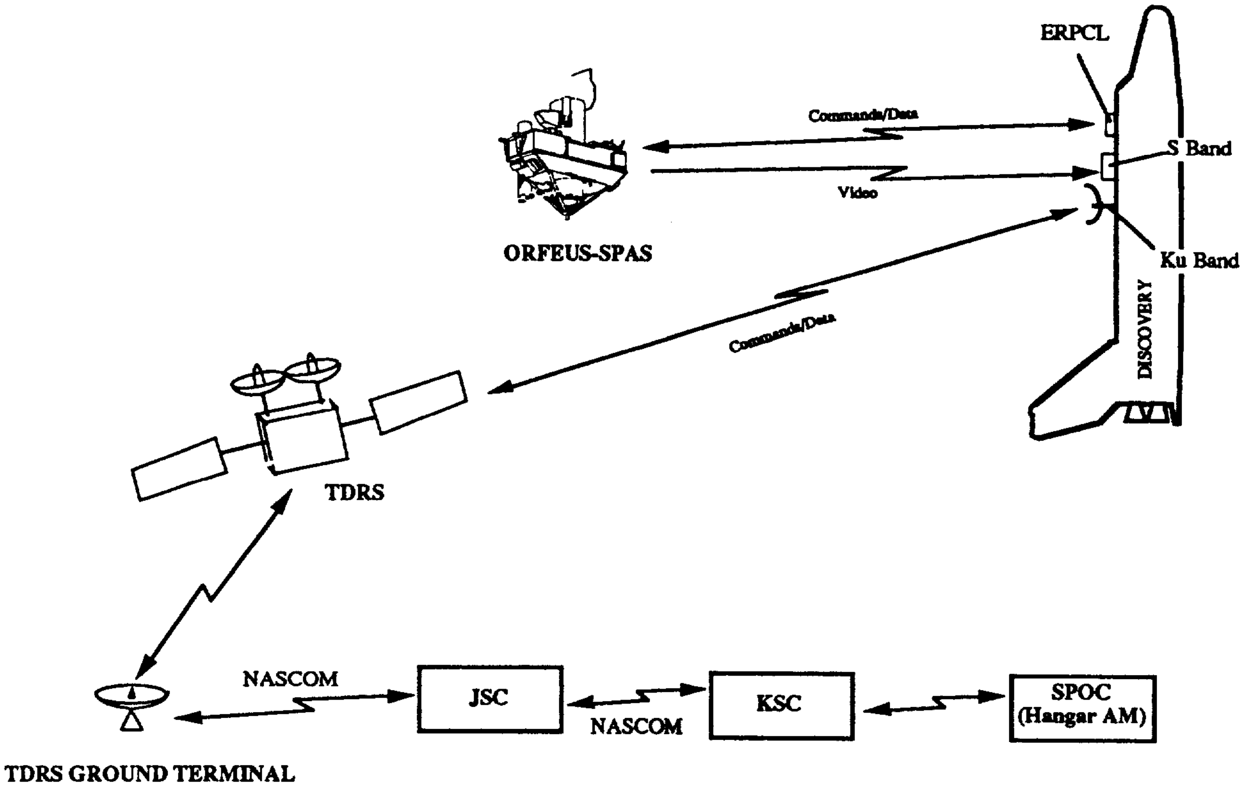


Figure 5.0-2 ORFEUS-SPAS Command and Data Links

All scientific decisions are made by an agreement of the members of the Joint Science Working Team (JSWT), chaired by the Mission Scientist, who are assisted by the Science Support Team. Decisions are communicated to the SPAS REP through the Mission Scientist. The JSWT team has input a desired list of targets to the SPAS program prior to launch. This target list was loaded into the SPAS system software and a pre-mission timeline was generated, which optimizes SPAS movements and resources required to achieve the prioritized targets. This file is maintained by the SPAS target file generator and is the responsibility of the SPAS Targets Manager (SPAS TM).

The SPAS Data Manager ensures that all data being downlinked from ORFEUS-SPAS are formatted correctly, distributed to the appropriate display console and archived for post-mission analysis.

The SPAS Systems Manager is responsible for the configuration and operation of all SPAS SPOC ground systems. He is supported by the System Support Team, which also supports the SPAS Targets Manager and the SPAS Data Manager.

Requests for mission timeline or procedural changes are made by the SPAS REP to the JSC Payload Officer in the Mission Control Center (MCC). Approved change requests are then forwarded to the flight control team for implementation. These change requests are communicated to the flight crew either via voice link or the Text and Graphics System (TAGS) which is similar to a fax machine. The Payload

Officer is supported at JSC by the Payload Data and Payload Systems functions who have direct voice links to their counterparts at the KSC SPOC.

Decisions that may impact mission resources will be made jointly by the DARA/NASA Mission Management Team. The MMT is composed of the NASA Program Manager, the NASA Program Scientist, the DARA Mission Manager, and the DASA SPAS Project Manager. Decisions of this type include reduction or extension of mission duration, or significant changes to the pre-flight mission plan.

6.0 Mission Management

Agreements between NASA and DARA are documented in the Memorandum of Understanding (MOU) for the ASTRO-SPAS series, signed in 1993, and the Joint Implementation Plan (JIP) for the ORFEUS-SPAS-1 mission. Deutsche Aerospace (DASA) has been designated as DARA's agent to negotiate and implement the lower level agreements such as the Payload Integration Plan (PIP) and the safety documentation process. DASA is also responsible for the configuration and operation of the SPOC. The ORFEUS-SPAS-1 mission team reports to the Mission Manager, with consultation from NASA HQs and DARA management. The Joint Science Working Team (JSWT) is chaired and represented to the mission team by the Mission Scientist and consists of representatives from AIT, Princeton, UCB, and representatives from RICS and SESAM as observers. The NASA Program Scientist serves as an ex-officio member of the JSWT.

The majority of integration and testing for ORFEUS-SPAS-1 occurred in Germany. Therefore, the NASA Wallops Transportation Office was instrumental in providing shipping and import/export support to the successful execution of the ORFEUS-SPAS-1 mission.

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